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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to consider policy and implementation refinements to the Energy Storage Procurement Framework and Design Program (D.13-10-040, D.14-10-045) and related Action Plan of the California Energy Storage Roadmap.	Rulemaking 15-03-011 (Filed March 26, 2015)

ADMINISTRATIVE LAW JUDGE'S RULING SEEKING COMMENTS ON JOINT STAFF PROPOSAL

Parties have been participating in the California Independent System Operator's (CAISO's) ongoing Energy Storage and Distributed Energy Resources (ESDER) stakeholder initiative to enable wholesale market level participation of energy storage systems interconnected to the distribution grid. Parties previously had the opportunity to comment on a number of questions regarding Multiple-Use Applications for energy storage resources posed in the Scoping Ruling in this proceeding as well as in the CAISO ESDER process.

On May 3, 2016 staff of the California Public Utilities Commission and the CAISO held a workshop on station power and multiple-use applications for energy storage resources. Attached to this ruling is the Joint Workshop Report and Framework – Multiple Use Applications for Energy Storage, in CPUC Rulemaking 15-03-011 and CAISO ESDER 2 Stakeholder Initiative. This report proposes a multiple-use application framework, based on input received at the workshop, and subsequent comments and reply comments.

The Joint Staff Proposal includes 16 proposed rules for the treatment of Multiple-Use Applications for electric storage devices based on analysis of the comments and the workshop process. This ruling provides the final opportunity for parties to weigh in on the treatment of Multiple-Use Applications for electric storage devices at this time and identifies 15 specific questions that it seeks answers to, in order to finalize the framework and rules.

IT IS RULED that:

1. Energy Division and the California Independent System Operator will jointly hold a workshop on Friday, June 2, 2017, at the Commission's office in San Francisco, to discuss the attached Joint Staff Proposal on Multiple-Use Applications for Energy Storage. Energy Division shall separately notice the workshop.

2. Parties may file comments on the Joint Workshop Report and Framework – Multiple Use Applications for Energy Storage set forth at pages 18 - 20 in the attached Joint Staff Proposal two weeks following the joint workshop described above. Comments are due on June 16, 2017.

3. Parties may file reply comments on the Joint Staff Proposal on Multiple-Use Applications for Energy Storage set forth at pages 18-20. Reply comments are due on June 23, 2017.

Dated May 18, 2017, at San Francisco, California.

/s/ MICHELLE COOKE
Michelle Cooke
Administrative Law Judge

ATTACHMENT

Joint Workshop Report and Framework
Multiple-Use Applications for Energy Storage
CPUC Rulemaking 15-03-011 and
CAISO ESDER 2 Stakeholder Initiative

May 15, 2017

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Joint Staff Proposal on Multiple-Use Applications for Energy Storage

Introduction

On May 3, 2016 the California Public Utilities Commission (CPUC or Commission) and the California Independent System Operator (CAISO) held a workshop on the topic of multiple-use applications (MUA) of energy storage systems. The workshop was part of both CPUC Energy Storage Rulemaking (R.) 15-03-011 Track 2 and the CAISO's Energy Storage and Distributed Energy Resources Phase 2 (ESDER 2) stakeholder initiative. Parties to Rulemaking (R.) 15-03-011 filed post-workshop comments and reply comments on multiple-use applications on May 13th and 20th, respectively. At the workshop, both a vision and problem statement were presented, to guide this effort. We modify these vision and problem statements slightly, only to reflect the breadth of applications addressed in this paper, and reiterate them here:

> **Problem statement:** Current market rules do not support stacking of incremental values that energy storage systems can provide to the wholesale market, distribution grid, transmission system, and end users. As a result, energy storage cannot yet provide the full scope of multiple benefits and services it is capable of and realize its full economic value to the electricity system.
>
> **Vision:** To enable energy storage systems to stack incremental value and revenue streams by delivering multiple services to the wholesale market, distribution grid, transmission system and end users. Achieving this vision increases the value of storage, and potentially other forms of energy resources, and enhances its economic viability and cost-effectiveness.

The purpose of this staff proposal is to present a clear path forward for multiple-use applications for storage. Based on CPUC and CAISO staff's review of comments, it is clear that two major tasks are required to address the issues raised. The first task is to define clear rules for which combinations of revenue streams storage providers may access. The second task is to identify and propose ways to address regulatory and market barriers to storage applications in each of the three grid domains – consumer, distribution and transmission/wholesale. This paper covers both tasks.

This paper describes the CPUC and CAISO staff's proposed policies and principles for the uses that may be stacked and compensated. This paper also summarizes a concrete set of MUA storage barriers raised in party comment or that staff has identified. Finally, this paper summarizes barriers to storage within the three grid domains and makes some recommendations, as appropriate within the scope of the directly relevant proceeding, Rulemaking (R.) 15-03-011 and CAISO Energy Storage and Distributed Energy Resources (ESDER) stakeholder initiative. We invite parties to raise issues and barriers that are outside of either aforementioned process so that staff can develop and provide an updated list of priority issues.

Next Steps

We require additional input from stakeholders to finalize both the regulatory framework for multiple use applications, and station power rules adopted in CPUC Decision (D.) 17-04-039. To that end, we request input from parties in two formats. The first is a workshop, which will occur in advance of party comments. The CPUC Energy Division and CAISO will jointly hold a workshop to discuss the contents of this paper with parties on **Friday, June 2, 2017**, at the CPUC in San Francisco. Workshop details will be noticed separately. Second, we request written party comments on a list of questions to be submitted following the workshop, designed to further build the record. These questions and next steps are woven throughout this paper and summarized at the end. Comments are due on **June 16, 2017** and Reply Comments are due on **June 23, 2017**.

Principles: Domain, Service and Time

We start by defining some basic terms and parameters to guide our multiple use application framework. This discussion is organized into three key areas – domain, service, and time.

Domain

Domain generally refers to the categorization of both the physical point of interconnection, or location on the grid, of a storage device, as well as the categorization of uses, or services, that are possible. We define two types of domain – grid domains and service domains – below:

- *Grid Domain:* Grid domain refers to the physical point of interconnection of the storage asset. Grid domains are the same three domains defined in Decision (D.) 13-10-040, and around which the California storage mandate is designed. Those three grid domains are: customer (i.e., behind the end use customer meter), distribution, and transmission. These domains have been defined previously in this proceeding, and we do not reiterate that definition here.

- *Service Domain:* Service Domain refers to the five (5) distinct areas in which a resource may provide services. In consideration of comments, and the specifics and complexities of California's unique electricity market design, we propose redefining the domains that have been used to date. As shown in Table 1, the definition we propose here includes the three domains, transmission, distribution and customer, as defined by Decision (D.) 13-10-040, and adds the wholesale market and resource adequacy as two separate additional domains.

Service

The term service, as we use it here, is synonymous with "use". Thus, the term *multiple use applications* is synonymous with *multiple service applications*. Within each domain there are several possible services, or uses, that a storage device may provide. For example, in the end-use customer domain the device may provide time-of-use load shifting and demand-charge management; in the transmission/wholesale domain a device may provide energy, contingency reserves, and regulation. We propose twenty (20) services across these five domains.

Table 1. Service Domains & Services

Service Domain	*Service*
Customer	TOU bill management
	Demand charge management
	Increased PV self-consumption
	Back-up power
Distribution[1]	Distribution capacity/deferral
	Reliability (back-tie) services
	Voltage support
	Resiliency/microgrid/islanding
Transmission	Transmission deferral
	Black start
	Voltage Support
	Inertia
	Primary frequency response
Wholesale Market	Frequency regulation
	Imbalance energy
	Spinning Reserves
	Non-spinning reserves
Resource Adequacy	System RA capacity
	Local RA capacity
	Flexible RA capacity

Each one of these services is generally distinct from the other, and there is not cross-over of services between grid domains. For example, a storage device cannot provide distribution deferral to both the distribution and wholesale domains at the same time, because distribution deferral is specific to the distribution grid domain. However, as discussed further below, a storage device providing distribution deferral may also provide other services.

Note that a resource physically interconnected in one grid domain may provide primary services in another domain, provided that the other domain is at a higher hierarchical level than

[1] For distribution-level services, the rules, procurement procedures and the services themselves are currently in development in a separate Commission Rulemaking (R.) 14-10-003, the Integrated Distributed Energy Resources (IDER). Ordering Paragraph 2 of Decision (D.) 16-12-036 in R.14-10-003 defines these four product types. Should the product types be modified in R.14-10-003 or a subsequent proceeding, the product types on the distribution system available to storage resources will automatically update.

the resource's grid domain. For example, customer-sited resources may provide services in any of the service domains. Distribution-connected resources may provide distribution and transmission-level services, but not customer services. Services in the wholesale market and resource adequacy service domains may be provided by resources located in any grid domain.

Some services may have specific performance requirements or require direct control of the device by either the grid operator or the transmission or distribution company. For example, frequency regulation at transmission level requires that the resource respond to control signals from the ISO's automatic generation control (AGC) system. Also, depending on the specific situation, transmission deferral may require direct control by the ISO or specific behavior by the resource such as maintaining unloaded generation capacity for use in a contingency event. Another transmission service, primary frequency response, requires a decentralized control response at the resource level, meaning that the resource is configured to detect and respond to a frequency event without any signal from a centralized mechanism such as AGC. In some instances performance requirements may be stipulated in standards or interconnection agreements. Services to the transmission and wholesale domains are defined in the ISO tariff and any modifications to those, if warranted, are outside the scope of the present effort and would be addressed through ISO initiatives.

We anticipate that reliability services in the distribution service domain may require direct control by the utility distribution company (UDC). We do not, however, adopt any rules relating to these distribution services here, and defer to the Integrated Distributed Energy Resource (IDER) and Distribution Resources Plan (DRP) proceedings. Further, as the storage market evolves more services than those listed here may be identified and require direct control of the device by the grid operator or the transmission or distribution company per the contractual obligations established. We don't seek to pre-determine all possible arrangements, but we do need to establish some basic principles and rules for stacking of services and priority of dispatch around which the market should conform.

Proposed Rules for Provision of Services in Domains

We propose the following rules with regard to provision of services in grid domains:

1) Resources interconnected in the customer domain may provide services in any domain.
2) Resources interconnected in the distribution domain may provide services in all domains *except* the customer domain.
3) Resources interconnected in the transmission domain may provide services in all domains *except* the customer or distribution domains.
4) Resources interconnected in any grid domain may provide resource adequacy, transmission and wholesale market services.
5) Resources providing transmission deferral (i.e., implemented in lieu of a transmission infrastructure investment) may have specific performance or direct control

requirements depending on the specific location and nature of the transmission facility being deferred.

6) Resources providing distribution deferral may have specific performance or direct control requirements. We do not adopt any such requirements here, but note that they may be created in the future if deemed necessary in either this, or a companion, Rulemaking such as IDER.

Appendix C includes a series of tables that visually put all of the aforementioned pieces together to illustrate what MUAs may be actualized by a single storage device, in any domain.

Reliability, Non-Reliability and Resource Adequacy Services

In our review of services, as well as party input, it is clear that it is useful to designate certain services as crucial to the reliable operation of the electricity system. To this end, in this section, we discuss special rules for reliability services and resource adequacy services, in multiple use applications.

Reliability and Non-Reliability Services

First, we designate certain services as "reliability services" and others as "non-reliability services" in Table 2, below. Reliability services are generally defined as services that are essential to grid reliability and must be available and perform as required when called.

Table 2. Reliability Services and Non-Reliability Services

Domain	Reliability Services	Non-Reliability Services
Customer	None	TOU bill management; Demand charge management; Increased PV self-consumption; Back-up power
Distribution	Distribution capacity deferral; Reliability (back-tie) services[2]	Voltage support; Resiliency/microgrid/islanding
Transmission	Transmission deferral; Inertia; Primary frequency response; Voltage support; Black start	None
Wholesale Market	Frequency regulation; Spinning reserves; Non-spinning reserves	Imbalance energy
Resource Adequacy	Local capacity; Flexible capacity	System capacity

[2] Of the distribution level services identified in R.14-10-003, we preliminarily adopt two services as distribution reliability services - distribution capacity services and reliability back-tie services. We note that the definition of these services may change as the IDER proceeding evolves.

Reliability Services

For reliability services, there can be reliability impacts to the system if the resource does not follow instructions from the ISO or utility distribution company (UDC), so much so that simply relying on market prices or penalizing a resource financially for not being available for its contractual obligation may be an insufficient incentive. For example, in the case that a storage device is providing transmission or distribution service, and the provision of that service means that the ISO or UDC have foregone transmission and distribution upgrades, it is very important for the reliability and safety of the grid that the resource actually be available and perform as needed. Provision of such services in real time should not be left entirely to the resource operator's financial optimization.

However, we are cognizant of the reality that resource owners will likely develop storage projects in a capacity greater than is required to fulfill any one obligation, to maximize their ability to provide multiple services while minimizing exposure to penalties for non-performance or for some other reason. This points to the potential for using different portions of a resource's capacity to provide different services, which we discuss further below. There is no good reason to prevent a storage provider from increasing its service options and managing its risk in this manner as long as the provision of reliability services is guaranteed.

For non-reliability services, the Commission and the ISO agree with designing effective market price signals, financial incentives and possibly penalties associated with each use in a multi-use application in order to drive prioritization of those services, rather than establishing a strict priority of service to which the resource must be dedicated all of the time, regardless of whether the storage provider is utilizing the same or different capacity. Market price signals, financial incentives and penalties may include rates and tariffs applicable to a service, imbalance energy settlement in the wholesale market, as well as specific penalties for non-performance.

Proposed Rules for MUAs with Reliability Services

In the following rules we allow for the possibility that a storage resource may commit different portions of its total capacity to different services. This approach enables the same resource to provide multiple services while stipulating that the same capacity may not be used to provide more than one service.

7) A storage device providing a reliability service may not perform any activities that would prevent its performance of the reliability service when needed.
8) If one of the services provided by a storage device is a reliability service, then that service must have priority.
9) Priority means that a single storage device may not contract for two or more different reliability services from the same capacity in a single, or multiple, domains.

10) If the reliability service is procured to avoid or defer a transmission or distribution asset upgrade, the resource must comply with availability and performance requirements specified in its contract with the relevant authority.
11) For reliability services in the transmission and distribution domains, the ISO and UDC, respectively, may require the resource to respond to a direct operating instruction or a control signal rather than a normal market dispatch. This could mean, under the ISO tariff for example, that failure to perform as directed could constitute a tariff violation. Such a tariff violation may be either in place of, or in addition to, a financial penalty for not providing the service.
12) A resource that is compensated as a transmission asset for transmission deferral cannot provide other reliability or market services or RA from the same capacity. If a resource is deferring a transmission upgrade it may be required to retain available unloaded capacity that cannot be used for any other service in any domain in order to be able to respond to a contingency event when needed. The precise requirements will typically depend on the location and the specific transmission upgrade being deferred.

Resource Adequacy Capacity

Resource adequacy (RA) capacity is classified as system, local, or flexible. The counting rules for system and local RA define the qualifying capacity (QC) of a storage resource to be the maximum discharge rate the resource can sustain for four hours. Thus a storage resource that can store 4 MWh of energy would typically be able to sustain a 1 MW discharge rate for 4 hours and would therefore qualify to provide 1 MW of system or local RA capacity.[3]

If a storage resource receives a capacity payment, and is counted toward a load serving entity's resource adequacy obligation, then it must participate in the wholesale market and be subject to a must-offer obligation. A must-offer obligation (MOO) is a requirement to bid or schedule the capacity into the ISO's day-ahead and real-time markets in accordance with specific ISO tariff provisions, and to be able to perform to fulfill its ISO schedule or dispatch instructions. This is important to this discussion of multiple use applications, because the MOO requires the resource to participate in the market during specific time periods and with specific rules. The section below describes those rules.

An important feature of the RA MOO is that they apply only to bid submission by the RA resource to the ISO day-ahead and real-time markets. The MOO as structured today does not address real-time performance by the resource. This means that once a resource has received an ISO day-ahead schedule for energy or ancillary services or a real-time dispatch, the ISO makes no distinction between RA and non-RA resources when it comes to real-time performance. Any resource that deviates from its ISO schedule or dispatch instruction in real

[3] The counting rule for flexible capacity is somewhat more complicated because a storage resource's charging cycle can also provide flexibility value, so the flexible RA capacity of the same 1 MW / 4 MWh storage device could be somewhat greater than 1 MW. For purposes of this report we focus on system and local capacity.

time is subject to the uninstructed imbalance energy (UIE) settlement at the real-time locational price, but there is no penalty for such deviation. This treatment is the same for RA and non-RA resources. One question to be considered with regard to MUA is whether there should be a stronger financial incentive or some other mechanism to ensure that a storage resource that is paid to provide RA capacity actually delivers the capacity value through its real-time performance.

Even though a storage resource's qualifying capacity (QC) for system or local RA is defined by its 4-hour sustainable discharge rate, many storage devices can operate at a much higher discharge rate. Suppose a storage device that has 4 MWh storage capacity (thus having QC = 1 MW for RA by the counting rules) can actually discharge at a rate of 16 MW, which would use up its full charge in 15 minutes. Assuming the resource is authorized to operate at this level,[4] it is possible that the ISO market could use the resource in this manner if needed, in which case the resource would not be available for the full 4 hours. However, because this usage was instructed through the ISO market the resource would have met its MOO. Alternatively, if the resource used up its energy in some other activity outside the ISO market and was not available to the ISO as a result, it would fail to meet its MOO. As noted above, however, if the resource receives an ISO dispatch instruction and fails to comply, today it would be subject only to the UIE settlement. In a future with higher volumes of distributed energy storage able to participate in MUA, the UIE settlement may not be sufficient to ensure that RA resources deliver their full RA value.

We expect that, in practice, an energy storage resource providing RA capacity will not use the same capacity to engage in other services or activities that may deplete its stored energy so as to render it unavailable to fulfill its MOO. Further, as with reliability services, we are cognizant of the reality that, if financial incentives are sufficiently strong, resource owners will likely develop storage projects in a capacity greater than is required to fulfill any one obligation, to minimize exposure to any penalties. There is no good reason to prevent a storage provider from increasing its service options and managing its risk in this manner as long as the provision of the full resource adequacy value is guaranteed.

MOOs and Wholesale Market Products for Storage:

There are two main ISO participation models energy storage can utilize: proxy demand resource (PDR) and non-generator resource (NGR). This section details specific requirements of the PDR and NGR models, and their associated must-offer obligations (MOOs).

[4] The highest allowable rate at which a resource can discharge energy is set by the terms of its interconnection agreement. Thus if the resource in this example wanted to be able to operate at the 16 MW operating level it must have requested this operating level in its interconnection request and have satisfied all the requirements identified in the interconnection process.

Proxy demand resource (PDR):

Storage devices located behind the end-use customer meter can be used in their discharge cycle to reduce demand, to provide load management services to the customer or demand response (DR) to the ISO market. Under PDR, storage can never inject energy into the distribution or transmission grid; i.e., the energy discharge by the storage device cannot exceed the actual load behind the same end-use meter. The PDR may be a single storage device at one customer site or an aggregation of multiple devices at different customer sites; in the latter case each of the individual devices must comply with the "no injection" rule for DR.

PDR can only be dispatched in one direction – to reduce load – and is only visible to the ISO and settled in the ISO settlement system for market intervals in which the resource submits a bid and receives an ISO dispatch. Thus, the resource bids only its discharge capability to the ISO, to provide DR by offsetting load; its charging cycle is part of the retail load and therefore incurs retail rates for charging energy.[5]

In this scenario the normal rules for PDR providing RA apply. The resource must be able to operate at its RA net qualifying capacity (NQC) for 4 hours over 3 consecutive days up to a total of 24 hours per month. The resource must bid into the ISO day-ahead and real-time markets up until its 24 dispatch hours for the month have been exhausted; after that it has no further obligation to the ISO for that month.

Non-generator resource (NGR):

The ISO created the NGR model mainly to enable energy storage resources to participate in the ISO markets in a manner comparable to a generator. The main difference compared to a generator is that the NGR can have negative output at times (i.e., when the storage device is charging). In most other ways the NGR is comparable to a wholesale generator, regardless of whether it is connected to the ISO grid or to the distribution system. In fact, the storage device utilizing the NGR model could be located physically behind the end-use customer meter, but would have to be metered separately so that its activity at all times, whether charging or discharging, can be accurately separated from the end-use load.

One important feature of an NGR that differs from a PDR is that the NGR is visible to the ISO and settled in the ISO's settlement system 24x7. Regardless of whether the NGR submits a bid to the ISO, the ISO will receive its meter data and apply the wholesale energy settlement to the resource, the same as for any wholesale generator. This may be significant for a storage resource engaged in MUA, because it would mean that whatever activity the resource may perform for another entity – e.g., to provide services to the distribution utility – the energy production or consumption that results will be metered and settled in the ISO energy market.

[5] The ISO is working with stakeholders as part of the ESDER 2 initiative to consider the possibility of enhancing the PDR model to allow ISO dispatch to increase load. This question is still under discussion.

With regard to the RA MOO, an NGR is subject to the following rules, depending on whether it uses the regulation energy management (REM) model or more general non-REM model.[6]

Table 3. Must Offer Obligations

System or Local RA	Day-ahead Integrated Forward Market (IFM)	Day-ahead Residual Unit Commitment (RUC)	Real-time
Storage participates as non-REM NGR	Submit economic bids or self-schedules for positive output equal to the quantity of RA capacity, for all hours of the month the resource is physically available	RA capacity not scheduled in the IFM is automatically available at a price of $0 per MW	Submit economic bids or self-schedules for positive output equal to the quantity of RA capacity not scheduled in the IFM, for all hours of the month the resource is physically available
Storage participates as NGR-REM	Submit economic bids or self-provision of regulation service equal to the quantity of RA capacity, for all hours of the month the resource is physically available	RA capacity not scheduled in the IFM is automatically available at a price of $0 per MW	Submit economic bids or self-provision of regulation service equal to the quantity of RA capacity not scheduled in the IFM, for all hours of the month the resource is physically available
Storage participates as PDR	Economic Bids or Self-Schedules are to be submitted for RA Capacity that the market participant expects to be available per supply plan.	$0/MW RUC Availability Bids are to be submitted for all short and medium start RA Capacity for all hours of the month the resource is physically available. No RUC Availability Bids required for long-start RA Capacity.	Economic Bids or Self-Schedules are to be submitted for any remaining RA Capacity from resources scheduled in IFM or RUC. Economic Bids or Self-Schedules are to be submitted for all RA Capacity from Short-Start Units not scheduled in IFM.

Proposed Rules for MUAs with Resource Adequacy Capacity:

13) A storage device providing resource adequacy capacity should not perform any activities that could prevent an actual dispatch of that capacity when needed.
14) If one of the services provided by a storage device is resource adequacy capacity, in any grid domain, then that service must have priority.

[6] Under the REM model the resource is dedicated entirely to providing frequency regulation service. The more general non-REM NGR model allows the resource to provide other services in addition to regulation.

15) A single storage device may contract for both resource adequacy capacity and a reliability service using the same capacity. For example, if a storage resource is providing local resource adequacy capacity, it may meet its resource adequacy must offer obligation (MOO) by providing any service in the wholesale service domain using its resource adequacy capacity.

All Other Services

For any services that are not reliability services or resource adequacy services we do not assign any priority of uses here. For these services, it is appropriate to leave it to the contracting and interested parties to design incentives, penalties, and priority of service if applicable and appropriate to the specific use case. Our purpose in dictating priority and primacy of resource adequacy and reliability service is to ensure reliability of the grid.

Time – Coincidence or Simultaneity

The time realm comes into play in considering the potential for a resource engaged in a multiple use application to receive instructions from two or more different entities (e.g., the ISO and the distribution utility) to perform in a particular way at the "same time." The time refers to the actual period of time (ISO operating interval or wholesale settlement interval) in which a resource has a clear obligation to perform to a schedule, dispatch instruction, operating instruction or control signal. Conversely, "different time" means distinct time periods that do not overlap at all, but may occur within the same 24-hour period.

We introduce the time consideration to explore two issues: first, the potential for a resource to receive conflicting instructions for how to perform at a given time; and second, the potential for a resource to be double-compensated inappropriately for providing the same service.

To use an illustrative example: a resource may be providing system RA capacity and bid into the market for each hour of its must-offer obligation, which encompasses either a portion of each day (4 hours all non-holiday weekdays in the case of PDR) or the entirety of each day (NGR providing RA has a 24/7 bidding requirement), and also be providing – say – a distribution level service. "Same time" comes into play for a PDR only if the resource is actually dispatched in the wholesale market and also simultaneously called to provide distribution level service. In contrast, an NGR is a 24x7 wholesale resource and as such is settled in the ISO market in all operating intervals for energy it produces when discharging or consumes when charging, irrespective of whether the ISO issued it a schedule or dispatch instruction. Thus, "same time" for an NGR means any interval in which it responds to an instruction from an entity other than the ISO, because its response will be settled as UIE in the ISO market settlement. In other words, "same time" means the resource is responding to instructions from two different entities simultaneously, or in overlapping time periods.

Further, consideration of time only applies if the storage device provides the same service element, in the same or different domains. There are only two service elements – energy and capacity. So, if a storage device provides energy to both a host customer and the wholesale market at the same time, then the time consideration applies, as these are like services. If a storage device provides energy to the wholesale market and capacity to a utility at the same time, then these rules do not apply, and the resource may gain full compensation for each service.

We do not propose to prescribe any requirements now dealing with "when" a resource performs services, and reserve the ability to do so in the future. The proposed rules for each domain should avoid most concerns about conflicting instructions and double-compensation.

Questions for Parties:

1) Comment on the 5 service domains and 20 services identified. Is this list comprehensive? Should more services be added? Should any services be removed? Why or why not?
2) We invite parties to consider that, though there are 20 distinct services that a storage device may provide, there are arguably only two service elements – energy and capacity. Fundamentally, each of the above services requires the storage device to provide only one of these two services. Thus, we ask parties to comment on whether it is appropriate to further break down the 20 services into two service elements, and base our rules on those elements. Explain why or why not.
3) Are there additional considerations for prioritization of reliability and resource adequacy services that should be included here? Please be as specific as possible.
4) Offer any other comments on the list of proposed rules. Please be specific and provide supporting rationale.
5) Is it necessary to establish any rules with regard to "time" now? If so, what is the specific recommendation?
6) As an example of a potential "time" concern, suppose the ISO instructs a storage device not to discharge due to excess supply on the grid, and at the same time the customer instructs the device to discharge to reduce the customer's demand charge, and as a result the ISO must curtail some renewable generation on the grid. How can such situations best be prevented?
7) Existing ISO requirements associated with RA MOO are defined by the Resource Adequacy Availability Incentive Mechanism (RAAIM), which only addresses a resource's bidding behavior but not its actual real-time performance. Should the ISO consider stronger performance incentives for RA capacity to ensure the system receives the full value of procured RA capacity? For example, what would be effective incentives for a storage device to refrain from activities that would use up their stored energy and render them less than fully available during the RA performance hours?

Compensation Principles

We agree with the principle that storage devices may receive revenue from multiple services that are specific and measurable, if those services serve distinct system or customer needs. Moreover, we do not believe that simply providing the same energy or capacity for two different purposes or services counts as "double compensation" on its face. However, if energy or capacity is sold twice to provide the same need, at the same time and in the same domain, we are concerned that this counts as double compensation.

Incrementality

It is reasonable and desirable to permit storage systems to enjoy revenue from multiple services that are specific and measurable, if those services serve distinct system or customer needs. Services provided must be measurable, and the same service only counted and compensated once to avoid double compensation. As a general rule, a utility, UDC or the ISO should not be required to procure or pay for a service that the entity has already planned and paid for. To do so is the textbook definition of double compensation, which we wish to avoid.

Similarly, we would argue that the use of the metered generation output (MGO) baseline rule for behind-the-meter storage providing PDR in the ISO market is an appropriate application of the incrementality principle because it clearly separates the storage device's service to the end-use customer from its response to the PDR dispatch.

We propose the following *initial* rule to ensure incrementality of services:

> 16) Incrementality: In paying for performance of services, compensation and credit may only be permitted for those services which are incremental and distinct.

Some complications arise in trying to make this principle more precise and apply it to specific scenarios. We therefore request that parties comment the following questions.

8) It has been suggested that, for customer level services, compensation only be allowed for those services for which procurement has not already occurred, meaning the load-serving entity planned for the activity to occur and avoided investment in generation – short or long term – for that service. The purpose is to avoid stranded costs while also preventing double compensation. At the same time it appears to conflict with the ability of customers to manage their energy needs as they see fit. Should incrementality rules consider procurement to try to avoid contributing to stranded costs?
9) Are there other considerations or principles for avoiding double valuation or compensation for multiple services than what we describe here? Be as specific as possible, and include any proposed rules or actions needed to address the issues.
10) Are measurement and metering protocols required to ensure incremental compensation of services? If so, be as specific as possible.

Measurement and Metering[7]

In D.17-04-039, the Commission deferred deliberation of two aspects of station power policy for storage to this discussion of multiple use applications. The two aspects are:

- Station power rules for storage devices located behind the utility meter and also integrated into the wholesale market.
- Measurement and metering of station power for storage devices located in front of the utility meter, including alternative measurement schemes to direct metering.

To the first issue, as was recognized in D.17-04-039, this is a multiple use application that is occurring today. Storage resources located behind the utility meter are participating in the wholesale market, via such procurements as the Demand Response Auction Mechanism and several contracts resulting from SCE's 2013 local capacity requirement request for offers. In D.17-04-039, the Commission found merit in the concerns about potential improper avoidance of retail bill charges if customers are able to charge at wholesale and dispatch at retail outside of a response to a wholesale market dispatch. We seek more information here on the following topics in order to inform a final rule: development of protocols, processes, and specific metering configuration options for this scenario.

D.17-04-039 also defers the second issue to this paper on multiple use applications. The Decision states the Commission's support for "…fair and clear rules at the outset, and the use of dispute arbitration by CPUC staff only in the most unique of circumstances". The Decision also stated the recognition that "…some flexibility is needed at this nascent stage of the market". We seek more information here on the following topics in order to inform a final rule: impact of metering costs to smaller systems, the impacts of specific metering configurations to different storage system designs, and alternative measurement approaches.

Similar issues were raised in the MUA context, in party comments, that were raised in the station power context. This paper combines the issues. Following are specific questions designed to build a record sufficient to address both questions deferred to this paper by D.17-04-039, as well as any additional metering and measurement considerations and rules that must be put into place to enable certain multiple use applications.

Questions:

11) For systems located behind the utility meter, we proposed that systems that are submetered and participate in the wholesale market could charge storage devices at wholesale if that energy is used to fulfill a wholesale market obligation. The purpose of submetering would be to separately track wholesale and retail activity. Is submetering

[7] For purposes of this paper, these terms only refer to measurement and metering for settlement, and not any telemetry that may be required for observing performance in real time.

sufficient? Why or why not? What is the alternative, or what additional work would be required? Be as specific as possible and provide diagrams where relevant.

12) For systems located behind the utility meter, are there system configurations are easily suited to enable separate tracking of wholesale and retail activity? Would this configuration work across different system designs? Be as specific as possible and provide diagrams where relevant.
13) For systems located on either side of the utility meter, what is the all-in cost of installing and maintaining a separate meter on the facility? How does the cost of the meter compare to the total system cost. Estimate the impact on energy and/or capacity contract costs.
14) Some parties recommended a fixed set-aside for station power, such as a percentage of the resource's capacity, in lieu of direct metering. If we were to adopt such a set-aside, how would it be established and implemented?
15) Are there additional considerations or options, beyond those listed here, for measurement and metering of a storage device operating in a multiple use scenario? For any additional suggested measurement and metering options, does the recommendation work across different system designs?

Cost Recovery & Cost Allocation Principles

Additional comment on cost recovery and cost allocation is necessary, both in written form as well as a workshop, following publication of this paper to stakeholders. We recommend that parties include specific issues in this regard in comments on this paper.

Complete List – Proposed Rules for Multiple Use Applications

1) Resources interconnected in the customer domain may provide services in any domain.
2) Resources interconnected in the distribution domain may provide services in all domains *except* the customer domain.
3) Resources interconnected in the transmission domain may provide services in all domains *except* the customer or distribution domains.
4) Resources interconnected in any grid domain may provide resource adequacy, transmission and wholesale market services.
5) Resources providing transmission deferral (i.e., implemented in lieu of a transmission infrastructure investment) may have specific performance or direct control requirements depending on the specific location and nature of the transmission facility being deferred.
6) Resources providing distribution deferral may have specific performance or direct control requirements. We do not adopt any such requirements here, but note that they may be created in the future if deemed necessary in either this, or a companion, Rulemaking such as IDER.
7) A storage device providing a reliability service may not perform any activities that would prevent its performance of the reliability service when needed.

8) If one of the services provided by a storage device is a reliability service, then that service must have priority.
9) Priority means that a single storage device may not contract for two or more different reliability services from the same capacity in a single, or multiple, domains.
10) If the reliability service is procured to avoid or defer a transmission or distribution asset upgrade, the resource must comply with availability and performance requirements specified in its contract with the relevant authority.
11) For reliability services in the transmission and distribution domains, the ISO and UDC, respectively, may require the resource to respond to a direct operating instruction or a control signal rather than a normal market dispatch. This could mean, under the ISO tariff for example, that failure to perform as directed could constitute a tariff violation. Such a tariff violation may be either in place of or in addition to a financial penalty for not providing the service.
12) A resource that is compensated as a transmission asset for transmission deferral cannot provide other reliability or market services or RA from the same capacity. If a resource is deferring a transmission upgrade it may be required to retain available unloaded capacity that cannot be used for any other service in any domain in order to be able to respond to a contingency event when needed. The precise requirements will typically depend on the location and the specific transmission upgrade being deferred.
13) A storage device providing resource adequacy capacity should not perform any activities that could prevent an actual dispatch of that capacity when needed.
14) If one of the services provided by a storage device is resource adequacy capacity, in any grid domain, then that service must have priority.
15) A single storage device may contract for both resource adequacy capacity and a reliability service using the same capacity. For example, if a storage resource is providing local resource adequacy capacity, it may meet its resource adequacy must offer obligation (MOO) by providing any service in the wholesale service domain using its resource adequacy capacity.
16) Incrementality: In paying for performance of services, compensation and credit may only be permitted for those services which are incremental and distinct.

Complete List – Questions for Parties

Principles: Domain, Service and Time:

1) Comment on the 5 service domains and 20 services identified. Is this list comprehensive? Should more services be added? Should any services be removed? Why or why not?
2) We invite parties to consider that, though there are 20 distinct services that a storage device may provide, there are arguably only two service elements – energy and capacity. Fundamentally, each of the above services requires the storage device to provide only one of these two services. Thus, we ask parties to comment on whether it

is appropriate to further break down the 20 services into two service elements, and base our rules on those elements. Explain why or why not.

3) Are there additional considerations for prioritization of reliability and resource adequacy services that should be included here? Please be as specific as possible.
4) Offer any other comments on the list of proposed rules.
5) Is it necessary to establish any rules with regard to "time" now? If so, what is the specific recommendation?
6) As an example of a potential "time" concern, suppose the ISO instructs a storage device not to discharge due to excess supply on the grid, and at the same time the customer instructs the device to discharge to reduce the customer's demand charge, and as a result the ISO must curtail some renewable generation on the grid. How can such situations best be prevented?
7) Existing ISO requirements associated with RA MOO are defined by the Resource Adequacy Availability Incentive Mechanism (RAAIM), which only addresses a resource's bidding behavior but not its actual real-time performance. Should the ISO consider stronger performance incentives for RA capacity to ensure the system receives the full value of procured RA capacity? For example, what would be effective incentives for a storage device to refrain from activities that would use up their stored energy and render them less than fully available during the RA performance hours?
8) It has been suggested that, for customer level services, compensation only be allowed for those services for which procurement has not already occurred, meaning the load-serving entity planned for the activity to occur and avoided investment in generation – short or long term – for that service. The purpose is to avoid stranded costs while also preventing double compensation. At the same time it appears to conflict with the ability of customers to manage their energy needs as they see fit. Should incrementality rules consider procurement to try to avoid contributing to stranded costs?
9) Are there other considerations or principles for avoiding double valuation or compensation for multiple services than what we describe here? Be as specific as possible.
10) Are measurement and metering protocols required to ensure incremental compensation of services? If so, be as specific as possible.

Measurement and Metering:

11) For systems located behind the utility meter, are there system configurations are easily suited to enable separate tracking of wholesale and retail activity? Would this configuration work across different system designs? Be as specific as possible and provide diagrams where relevant.
12) 1) For systems located behind the utility meter, we proposed that systems that are submetered and participate in the wholesale market could charge storage devices at wholesale if that energy is used to fulfill a wholesale market obligation. The purpose of submetering would be to separately track wholesale and retail activity. Is submetering

sufficient? Why or why not? What is the alternative, or what additional work would be required? Be as specific as possible and provide diagrams where relevant.

13) For systems located on either side of the utility meter, what is the all-in cost of installing and maintaining a separate meter on the facility? How does the cost of the meter compare to the total system cost. Estimate the impact on energy and/or capacity contract costs.
14) Some parties recommended a fixed set-aside for station power, such as a percentage of the resource's capacity, in lieu of direct metering. If we were to adopt such a set-aside, how would it be established and implemented?
15) Are there additional considerations or options, beyond those listed here, for measurement and metering of a storage device operating in a multiple use scenario? For any additional suggested measurement and metering options, does the recommendation work across different system designs?

Regulatory Barriers to Multiple Use Applications

This section describes regulatory barriers, issues and conflicts, embedded in existing regulations, which currently inhibit multi-use applications that are within the scope of either this Rulemaking (R.15-03-011) or the CAISO's ESDER stakeholder initiative. For those issues outside of the scope of either R.15-03-011 or ESDER, we highlight the issues for further consideration in the appropriate venue. The ISO does expect to open an ESDER Phase 3 initiative later this year, so parties who identify issues that should be addressed in an ISO initiative should suggest them for ESDER 3.

Customer Grid Domain – Behind the Meter (BTM)

CESA raises the issue that some RFOs do not allow for all for storage resources in the customer domain to participate. CESA recommends that the Commission require IOUs to allow for all types of storage offers. We are only aware of one RFO process to date, in which storage was explicitly eligible to compete, that explicitly did not allow for participation of storage resources located in the customer domain. That RFO process involved the energy storage solicitations that occurred pursuant to Resolution E-4791, targeted specifically to alleviate risk of power shortages due to the gas leak at Aliso Canyon.

While we generally agree that BTM customer resources and grid-level resources should be given equal opportunity, we also recognize that there may be instances in which a single resource strategically located on the grid may be the most beneficial for targeted needs/solicitations. It is not clear that this was the case for SCE and SDG&E's Aliso Canyon Energy Storage (ACES) procurements. We, thus, agree in general with the principle of allowing all grid domains to compete, and recommend that all grid domains be eligible for all solicitations, unless the IOU justifies a need to prohibit procurement from a particular grid domain.

Distribution Grid Domain – In Front of Meter (IFOM)

Many parties[8] point to the fact that, while there exists large potential for providing distribution level services, there is currently a lack of defined procurement opportunities, performance requirements, or valuation of distribution level services. NRG highlights the distribution level services that are the most likely candidates for energy storage: deferral of new distribution network upgrades, and power to control distribution-level voltage.

As noted earlier in this paper, valuation, performance requirements, and procurement of distribution level services are the topics of two ongoing proceedings at the Commission. These two proceedings are the DRP and IDER dockets. We do not offer anything in addition to the work that is underway in these two dockets. Should the four services defined to date, and pasted below, change in any way through policy development in IDER, DRP or a related proceeding or action, then the list would automatically update in any policy we establish here for storage.

In addition, we recommend that, at a minimum, the 2018 storage RFO include these four services.

- "Distribution Capacity services are load-modifying or supply services that distributed energy resources provide via the dispatch of power output for generators or reduction in load that is capable of reliably and consistently reducing net loading on desired distribution infrastructure;
- Voltage Support services are substation and/or feeder-level dynamic voltage management services provided by an individual resource and/or aggregated resources capable of dynamically correcting excursions outside voltage limits as well as supporting conservation voltage reduction strategies in coordination with utility voltage/reactive power control systems;
- Reliability (Back-Tie) services are load-modifying or supply services capable of improving local distribution reliability and/or resiliency. Specifically, this service provides a fast reconnection and availability of excess reserves to reduce demand when restoring customers during abnormal configurations; and
- Resiliency (microgrid) services are load-modifying or supply services capable of improving local distribution reliability and/or resiliency. This service provides a fast reconnection and availability of excess reserves to reduce demand when restoring customers during abnormal configurations."[9]

[8] Stem, CESA, SolarCity, NRG and SCE.
[9] D.16-12-036 in R.14-10-003.

Wholesale Market Service Domain

In comments, both AMS and Stem recommend that the CAISO implement the meter generator output (MGO) methodology as an option for PDR resources. Both companies highlight that the Type 1 baseline in the CAISO's tariff does not work for storage, largely because of calculation of the 10-in-10 baseline. We note that the CAISO adopted the MGO baseline methodology in ESDER Phase 1.

PDR Issues

Stem, CESA and SolarCity recommend that the CAISO amend the PDR product to enable services beyond day-ahead energy. CESA points out that, using the MGO methodology, PDR settlement requires each storage device in an aggregation of BTM storage to be settled separately, which causes storage developers to overbuild their fleets. CESA's comment is not correct. It is true that each device has its own baseline against which its actual performance must be measured, but the ISO settlement for an aggregated PDR is based on the total output of all devices in the aggregation minus the total of the baseline values.

CESA also raises problems with ability of PDR storage resources to provide ancillary services in the CAISO wholesale energy markets. Specifically, CESA raises that no market compensation exists for frequency response, and recommends that the CAISO develop an in-market solution for primary frequency response, and also points out that tariff language specifying the need for resource synchronization may be inhibiting the ability of storage to provide spinning reserves.

The ISO has an initiative in progress, Frequency Response 2, to consider the need for and possible design of a primary frequency response market product.

SCE points out that a storage asset cannot simultaneously participate in a NEM and the wholesale market. We clarify that the CPUC has adopted no policy prohibiting NEM storage resources from participation in the wholesale energy market, and we do not do so here.

The rule SCE refers to is a provision FERC approved in its order approving the ISO's DER Provider (DERP) proposal. The provision excludes resources participating in a NEM tariff from being included in a DER aggregation under the DERP framework. SCE advocated for this provision at FERC based on the potential to double compensate for the energy output produced by BTM resources under NEM that simultaneously participate in the wholesale market, and the ISO and FERC agreed.

NGR Issues

Several parties[10] recommend that the CAISO amend the non-generator resource (NGR) model to allow NGR resources to be taken out of the market regularly. NGR currently has a 24/7 bidding requirement, such that the resource must always be available to the market.

Storage resources that participate in the wholesale market using the NGR model will be metered and settled by the ISO on a 24x7 basis, comparable to a generator. This means that the ISO will receive meter data for all market intervals and will settle all energy consumption and production in the wholesale market settlement, whether or not the NGR submits bids and receives schedules or dispatch instructions in all intervals. This treatment of NGR is the same irrespective of whether or not the resource provides RA capacity and has a MOO. The difference if the resource does provide RA capacity is that it has a 24x7 MOO which requires, as explained above, that it bid into the ISO market in all hours and be subject to the RAAIM. The CAISO does understand the desire expressed by some stakeholders to allow an NGR to be able to opt out of CAISO metering and settlement in some intervals, and will take up this issue in the next ESDER round in 2017.

[10] Stem, CESA, NRG, and SolarCity

Appendix A: Glossary

This report uses the following framework and definitions for describing multiple-use applications and considering their feasibility, impacts and potential barriers. The preliminary definitions and concepts listed here are developed in more detail in the body of the report.

Automatic Generation Control (AGC). Generation equipment that automatically responds to signals from the CAISO's EMS control in Real-Time to control the Power output of Generating Units within a prescribed area in response to a change in system frequency, tie-line loading, or the relation of these to each other, so as to maintain the target system frequency and the established Interchange with other Balancing Authority Areas within the predetermined limits.[11]

Contingency. A potential Outage that is unplanned, viewed as possible or eventually probable, which is taken into account when considering approval of other requested Outages or while operating the CAISO Balancing Authority Area or EIM Balancing Authority.[12]

Economic Bid. A Bid that includes quantity (MWh or MW) and price ($) for specified Trading Hours.[13]

Grid Domain. Grid domain refers to the physical point of interconnection of the storage asset. Grid domains are the same three domains defined in Decision (D.) 13-10-040, and around which the California storage mandate is designed. Those three grid domains are: customer (i.e., behind the end use customer meter), distribution, and transmission. These domains have been defined previously in this proceeding, and we do not reiterate that definition here.

Non-generator Resource (NGR). Resources that operate as either Generation or Load and that can be dispatched to any operating level within their entire capacity range but are also constrained by a MWh limit to (1) generate Energy, (2) curtail the consumption of Energy in the case of demand response, or (3) consume Energy.[14]

Non-Reliability Services. Non-reliability services are services on which the electric system, or an end-use customer, does not depend for reliable operation and delivery of electricity. As with reliability services, this distinction does not depend on how the service was procured.

Proxy Demand Response (PDR). A Load or aggregation of Loads that has the characteristics of a Proxy Demand Resource set forth in Section 4.13.5, satisfies all other requirements applicable to a Proxy Demand Resource set forth in the CAISO Tariff, and is capable of measurably and

[11] ISO Tariff Appendix A. April 1, 2017.
[12] Ibid.
[13] Ibid.
[14] Ibid.

verifiably providing Demand Response Services pursuant to the Demand Response Provider Agreement, including but not limited to Sections 4.1 and 4.2 of the Demand Response Provider Agreement and excluding Section 4.3 of the Demand Response Provider Agreement.[15]

Qualifying Capacity. The maximum Resource Adequacy Capacity that a Resource Adequacy Resource may be eligible to provide. The criteria and methodology for calculating the Qualifying Capacity of resources may be established by the CPUC or other applicable Local Regulatory Authority and provided to the CAISO. A resource's eligibility to provide Resource Adequacy Capacity may be reduced below its Qualifying Capacity through the CAISO's assessment of Net Qualifying Capacity.[16]

Regulation Energy Management. A market feature for resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation.[17]

Reliability Services. Reliability services are services on which the electric system (transmission or distribution) depend for reliable operation. For example, in the transmission domain reliability services include contingency reserves and any services that are specified for a device that is procured to avoid or defer a transmission infrastructure upgrade. In contrast, wholesale energy would be a wholesale market service. Note that this distinction does not depend on how the service was procured; i.e., contingency reserves are procured through the wholesale market. What matters is whether the service is critical for the reliable operation of the system.

Same vs. Different Capacity. Provisions governing MUA must distinguish between a resource as a whole and a specific unit or portion of that resource's capacity. In some cases where a resource may not provide two services with the same capacity, it may be possible for the resource to partition its capacity to provide the two services from different dedicated portions of its total capacity.

Self Schedule. The Bid component that indicates the quantities in MWhs with no specification of a price that the Scheduling Coordinator is submitting to the CAISO, which indicates that the Scheduling Coordinator is a Price Taker, Regulatory Must-Run Generation or Regulatory Must-Take Generation, which includes ETC and TOR Self-Schedules, Self-Schedules for Converted Rights, and Variable Energy Resource Self-Schedules.[18]

Service. Within each service domain there are several possible services that a storage device may provide. For example, in the end-use customer domain the device may provide time-of-use load shifting and demand-charge management; in the transmission/wholesale domain a device

[15] Ibid.
[16] Ibid.
[17] Ibid.
[18] Ibid.

may provide energy, contingency reserves, and regulation. We have defined 20 services for the California market.

Services:

- *TOU Bill Management* – Storage device located behind the meter enables a customer to minimize its exposure to high electricity rates. The customer can charge the storage device when rates are low and discharge the storage device when rates are high, thereby offsetting high electricity rates for the customer.

- *Demand Charge Management* – Storage device located behind the meter enables a customer to minimize its exposure to demand charges. The customer can use the discharge of the storage device to manage the periods of the highest peaks in electricity usage.

- *Increased PV Self-Consumption* – Storage paired with solar PV, behind the meter, allows for a customer to maximize its on-site consumption of solar energy by allowing the customer to store any excess energy on-site to use during hours when the PV system is not generating.

- *Back-up Power* – A storage device located behind the customer meter may enable a customer to have "back-up" power for a period of time in the event of a black out or brown out.

- *Distribution Capacity/Deferral* – Load-modifying or supply services that distributed energy resources provide via the dispatch of power output for generators or reduction in load that is capable of reliably and consistently reducing net loading on desired distribution infrastructure.

- *Reliability (Back-Tie) Services* – Load-modifying or supply services capable of improving local distribution reliability and/or resiliency. Specifically, this service provides a fast reconnection and availability of excess reserves to reduce demand when restoring customers during abnormal configurations.

- *Voltage Support – Distribution and Transmission* – Substation and/or feeder-level dynamic voltage management services provided by an individual resource and/or aggregated resources capable of dynamically correcting excursions outside voltage limits as well as supporting conservation voltage reduction strategies in coordination with utility voltage/reactive power control systems.

- *Resiliency/Microgrid/Islanding* – Load-modifying or supply services capable of improving local distribution reliability and/or resiliency. This service provides a fast reconnection

and availability of excess reserves to reduce demand when restoring customers during abnormal configurations."

- *Transmission Deferral* – Not an ISO tariff defined service at this time

- *Black Start* – The procedure by which a Generating Unit self-starts without an external source of electricity thereby restoring a source of power to the CAISO Balancing Authority Area following system or local area blackouts.[19]

- *Inertia* – Not an ISO tariff defined service at this time

- *Primary Frequency Response* – Not an ISO tariff defined service at this time

- *Energy* - The electrical energy produced, flowing or supplied by generation, transmission or distribution facilities, being the integral with respect to time of the instantaneous power, measured in units of watt-hours or standard multiples thereof, e.g., 1,000 Wh=1kWh, 1,000 kWh=1MWh, etc.[20]

- *Spinning Reserve* – The portion of unloaded synchronized resource capacity that is immediately responsive to system frequency and that is capable of being loaded in ten (10) minutes, and that is capable of running for at least thirty (30) minutes from the time it reaches its award capacity.[21]

- *Non-Spinning Reserve* – The portion of resource capacity that is capable of being synchronized and Ramping to a specified load in ten minutes (or that is capable of being interrupted in ten (10) minutes) and that is capable of running (or being interrupted) for at least thirty (30) minutes from the time it reaches its award capacity.[22]

- *Regulation* – The service provided either by resources certified by the CAISO as equipped and capable of responding to the CAISO's direct digital control signals, or by System Resources that have been certified by the CAISO as capable of delivering such service to the CAISO Balancing Authority Area, in an upward and downward direction to match, on a Real-Time basis, Demand and resources, consistent with established NERC and WECC reliability standards, and any requirements of the NRC. Regulation is used to control the operating level of a resource within a prescribed area in response to a change in system frequency, tie line loading, or the relation of these to each other so as to maintain the target system frequency and/or the established Interchange with other Balancing Authority Areas within the predetermined Regulation Limits. Regulation includes both an increase in Energy production by a resource or decrease in Energy

[19] Ibid.
[20] Ibid.
[21] Ibid.
[22] Ibid.

consumption by a resource (Regulation Up) and a decrease in Energy production by a resource or increase in Energy consumption by a resource (Regulation Down). Regulation Up and Regulation Down are distinct capacity products, with separately stated requirements and ASMPs in each Settlement Period.[23]

- *Resource Adequacy Resource* – A resource that is designated in a Supply Plan to provide Resource Adequacy Capacity. The criteria for determining the types of resources that are eligible to provide Qualifying Capacity may be established by the CPUC or other applicable Local Regulatory Authority and provided to the CAISO.[24]

    - *System RA Capacity* – CPUC Decision (D.) 05-10-042 first defined and established System RA for utilities under the jurisdiction of the CPUC.
    - *Local RA Capacity* – CPUC Decision (D.) 06-06-064 first defined and established Local RA for utilities under the jurisdiction of the CPUC.
    - *Flexible RA Resource* – CPUC Decision (D.) 13-06-024 recognized a need for flexible capacity in the RA fleet and defined flexible capacity for utilities under the jurisdiction of the CPUC.

Service Domain. Service Domain refers to the five (5) distinct areas in which a resource may provide services. In consideration of comments, and the specifics and complexities of California's unique electricity market design, we propose redefining the domains that have been used to date. As shown in Table 1, the definition we propose here includes the three domains, transmission, distribution and customer, as defined by Decision (D.) 13-10-040, and adds the wholesale market and resource adequacy as two separate additional domains.

Settlement Interval. The five-minute time period over which the CAISO settles cost compensation amounts or deviations in Generation and Demand in the RTM.[25]

Uninstructed Imbalance Energy (UIE). The portion of Imbalance Energy that is not RTD Instructed Imbalance Energy.[26]

[23] Ibid.
[24] Ibid.
[25] Ibid.
[26] Ibid.

Appendix B – Summary of Party Positions – MUA Principles

Priority of Uses

Parties offered significant comment on a very important issue – prioritization of uses in a multi-use scenario. When a storage resource is providing more than one service system needs will inevitably arise that requires one service taking priority over another, but the rules need to be established around which entity makes the prioritization decision and based on what factors. The IOUs generally recommend that the Commission define clear rules around prioritization of uses and dispatch, particularly when at least one of the uses includes a reliability service. SCE recommends that the Commission determine whether contractual obligations and penalties are enough to avoid conflicts between services if needs occur simultaneously. SDG&E notes that the rules are unclear as to how a resource may be shared between two grid domains or services, and also that the utility code of conduct may need to be revisited if a storage system has multiple obligations to the utility that are in both the generation and transmission/distribution domains. PG&E takes the specific position that distribution level services must be prioritized over all other uses for reliability purposes.

The storage industry, on the other hand, recommends a more dynamic, price and value-driven approach to prioritizing dispatch of resources, rather than prescribing priority as a rule. SolarCity points out that clear financial incentives would result in storage operators only signing contracts that would not result in conflicting dispatches. SolarCity also states that safety and contingency driven dispatch by the distribution operator would take precedence. Stem argues that the operation of storage systems and meeting contractual obligations, including dispatch priority, is best left in the hands of the storage operator. Stem goes on to recommend that the Commission design rules for storage dispatch with an eye to maximizing available value streams and removing obstacles. In other words, storage operators should be allowed to resolve possible conflicts in the actual use of storage resources by pursuing the best prices among multiple markets. CESA agrees with that distribution level services are important, but disagrees with PG&E's proposed approach.

CESA points out that measure of System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) should inform the prioritization of distribution level services. SAIDI is the amount of time a utility's average customer experiences an outage of more than five minutes in duration in a given year. SAIFI is the number of times a utility's customer experiences an outage of more than five minutes in a given year. CESA suggests that if the SAIDI and SAIFI are low, then there is no need to always prioritize distribution level reliability. In evaluating the SAIDI and SAIFI indices of all three IOUs we find that, in 2015, the annual average duration of distribution level outages is short – an average of

85 minutes per customer[27] – and their annual average occurrence infrequent – an average of less than one outage per customer[28].

TURN comments that simply letting storage operators pursue the highest revenue opportunity may work in theory, but may also lower the value of storage resources to the grid as the capacity may be less reliable than that from other resources that do not pursue multiple revenue streams in different domains.

PG&E argues that utilities must have insight into resource performance and dispatch for distributed energy resource provider (DERP) aggregations. Specifically, PG&E recommends that the Commission develop rules to ensure that transmission and distribution operators coordinate aggregated DER dispatch with the CAISO, the operational visibility and control for distribution operations, and institute performance requirements.

Compensation Principles

All parties agree that storage devices should not be compensated twice for the same service, referred to as "double compensation" here forward. There are differing opinions of how "same service" should be defined, for purposes of MUA. PG&E, for example, refers to capacity and energy each as "services", and argues that no storage device should enjoy more than one capacity or energy payment. On the other side of the spectrum, SolarCity recommends that if the prices for the individual services are established independently from each other, then there is no double payment, and the storage resource may enjoy the full revenue.

Green Charge Networks recommends that the Commission look to the structure employed in New York, which allows for providing both distribution and transmission level reliability. If events are called simultaneously, the resource is paid once for energy and twice for capacity – to compensate for the services provided in each grid domain.

Many parties[29] advocate the principle that if more than one service is provided by a single storage device, then the services must individually represent distinct system needs for which procurement would otherwise occur. TURN similarly states that it could be appropriate for a storage device to receive multiple revenue streams for taking a single action that provides specific, measurable services to multiple markets.

There is a convergence of opinion among parties that compensation for any service should be incremental, unique, real and measurable, to avoid double compensation. IEP urges the Commission and CAISO to impose metering requirements that track operation of storage systems and delivery of products to the grid.

[27] SAIDI measurements for 2015 are as follows: SCE – about 100 minutes/customer; PG&E – 96 minutes/customer; and, SDG&E – about 58 minutes/customer.
[28] SAIFI measurements for 2015 are as follows: SCE – 0.86; PG&E – 0.871; and, SDG&E – 0.5261.
[29] SCE, NRG, Stem, and CESA

Both SDG&E and ORA request additional workshops on MUA. ORA's request is general, while SDG&E recommends focusing on BTM issues.

TURN recommends that revenue be based on actual benefits, and only may be earned if an actual market transaction occurs or an expense or new capital investment is truly avoided. TURN further recommends that the Commission review how well PPA provisions prevent double payment concerns in approving contracts for storage.

Cost Recovery & Cost Allocation Principles

Both SCE and SDG&E recommend that the Commission develop an appropriate cost recovery and cost allocation framework to facilitate MUAs, as well as a workshop.

Appendix C – Combinations of Services Using the Same Capacity

*The following tables illustrate the services that may be combined using the same capacity, per the rules set forth in this paper. These rules do not apply to resources providing services using entirely different capacity. Where "yes" is noted, the services may be combined without limit. Resource adequacy services have a separate table.

	Table 1. MUAs with Customer-Level Services			
	TOU bill management	*Demand charge management*	*Increased PV self-consumption*	*Back-up power*
Customer				
TOU bill management		Yes		
Demand charge management	Yes		Yes	
Increased PV self-consumption	Yes			Yes
Back-up power		Yes		
Distribution				
Distribution capacity deferral - RS	Distribution level services must have priority.			
Reliability (back-tie) services - RS				
Voltage support	Yes			
Resiliency/microgrid/islanding				
Transmission				
Transmission deferral - RS	Transmission level reliability services must have priority. If providing Tx deferral, the resource may have specific performance requirements depending on the specific need. BTM resources in the demand forecast are not visible to the ISO, but may offset the need for transmission by reducing load.			
Inertia - RS				
Primary Frequency Response - RS				
Black Start - RS				
Voltage Support - RS				
Wholesale Market				
Spinning and non-spinning reserves - RS	Wholesale market reliability services must have priority.			
Frequency Regulation - RS				
Imbalance Energy	Yes			

<table>
<tr><td></td><td colspan="4">Table 2. MUAs with Distribution Level Services</td></tr>
<tr><td></td><td>Dist capacity deferral - RS</td><td>Reliability (back-tie) services - RS</td><td>Voltage support</td><td>Resiliency/microgrid/islanding</td></tr>
<tr><td>Customer</td><td colspan="4"></td></tr>
<tr><td>TOU bill management</td><td colspan="2" rowspan="4">Distribution level reliability services must have priority.</td><td colspan="2" rowspan="4">Yes</td></tr>
<tr><td>Demand charge management</td></tr>
<tr><td>Increased PV self-consumption</td></tr>
<tr><td>Back-up power</td></tr>
<tr><td>Distribution</td><td colspan="2" rowspan="3"></td><td colspan="2"></td></tr>
<tr><td>Distribution capacity deferral - RS</td><td colspan="2" rowspan="2">Distribution level reliability services must have priority.</td></tr>
<tr><td>Reliability (back-tie) services - RS</td></tr>
<tr><td>Voltage support</td><td colspan="2" rowspan="2">Distribution level reliability services must have priority.</td><td></td><td>Yes</td></tr>
<tr><td>Resiliency/microgrid/islanding</td><td>Yes</td><td></td></tr>
<tr><td>Transmission</td><td colspan="2" rowspan="7"></td><td colspan="2"></td></tr>
<tr><td>Transmission deferral - RS</td><td colspan="2" rowspan="4">Transmission level reliability service must be prioritized. If providing Tx deferral, the resource may have specific performance requirements depending on the specific need.</td></tr>
<tr><td>Inertia - RS</td></tr>
<tr><td>Primary Frequency Response - RS</td></tr>
<tr><td>Black Start - RS</td></tr>
<tr><td>Voltage Support - RS</td><td colspan="2"></td></tr>
<tr><td>Wholesale Market</td><td colspan="2"></td></tr>
<tr><td>Spinning and non-spinning reserves - RS</td><td colspan="2" rowspan="2">Wholesale market reliability services must be prioritized.</td></tr>
<tr><td>Frequency Regulation - RS</td><td colspan="2"></td></tr>
<tr><td>Imbalance Energy</td><td colspan="4">Yes</td></tr>
</table>

	Table 3. MUAs with Transmission-level Services				
	Tx deferral - RS	*Inertia - RS*	*Primary Frequency Response - RS*	*Black Start - RS*	*Voltage Support - RS*
Customer					
TOU bill management	Transmission level reliability services must have priority. If providing Tx deferral, the resource may have specific performance requirements depending on the specific need. BTM resources in the demand forecast are not visible to the ISO, but may offset the need for transmission by reducing load.				
Demand charge management					
Increased PV self-consumption					
Back-up power					
Distribution					
Distribution capacity deferral - RS					
Reliability (back-tie) services - RS					
Voltage support	Transmission level reliability service must be prioritized. If providing Tx deferral, the resource may have specific performance requirements depending on the specific need.				
Resiliency/microgrid/islanding					
Transmission					
Transmission deferral - RS					
Inertia - RS					
Primary Frequency Response - RS					
Black Start - RS					
Voltage Support - RS					
Wholesale Market					
Spinning and non-spinning reserves - RS					
Frequency Regulation - RS					
Imbalance Energy					

	Table 4. MUAs with Resource Adequacy		
	Local capacity - RS	*Flexible capacity - RS*	*System capacity*
Customer			
TOU bill management	Yes, resource adequacy reliability service must be prioritized.		Yes
Demand charge management			
Increased PV self-consumption			
Back-up power			
Distribution			
Distribution capacity deferral - RS			Yes, distribution level reliability service must be prioritized.
Reliability (back-tie) services - RS			
Voltage support	Yes, resource adequacy service must be prioritized.		
Resiliency/microgrid/islanding			
Transmission			
Transmission deferral - RS			
Inertia - RS			Yes, transmission level reliability service must be prioritized.
Primary Frequency Response - RS			
Black Start - RS			
Voltage Support - RS			
Wholesale Market			
Spinning and non-spinning reserves - RS	RA capacity may fulfill its RA must-offer obligation by providing any wholesale market service.		
Frequency Regulation - RS			
Imbalance Energy			

[END OF ATTACHMENT]